Beyond the glass house icons: graphic documentation of the correlations between Bo Bardi's and Johnson's studios

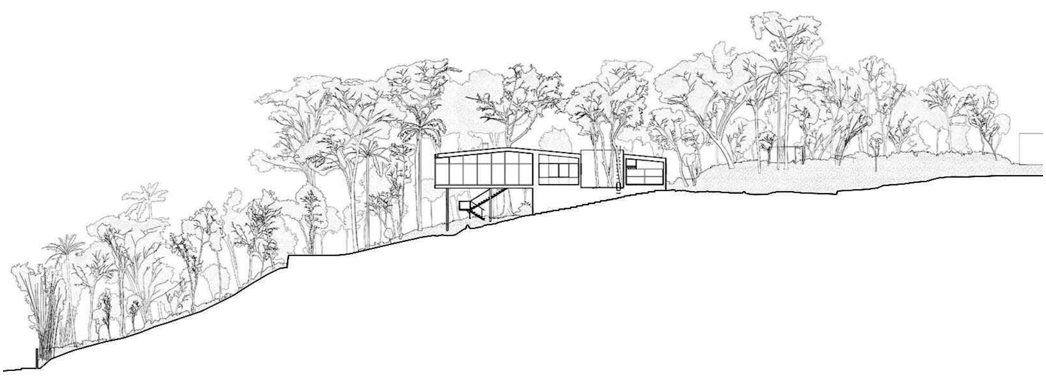
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Abstract

The importance of the glass houses in the history of architecture may be traced back to the way architecture became linked to steel and glass during the Industrial Revolution. The renowned Crystal Palace was the first monument of the innovation age, constructed of plate glass. It was built in 1851 in Hyde Park to host the Great Exhibition and then rebuilt at Sydenham, on top of a hill. Later, in 1914, Le Corbusier created the "Maison Dom-Ino," a global model that displayed the foundations and has been declared the prototype for a modern glass house. Undoubtedly it was Mies van der Rohe that had a pivotal role in the evolution of the modern glass house building in the Chicago suburbs in 1945, is set in a semi-rural micro-environment surrounded by nature his Farnsworth House. Hence, the object of study of this research are the glass houses designed by Lina Bo Bardi in 1949, São Paulo, and Philip Johnson, also designed in 1948 but located in New Canaan, Connecticut. Given the research's scope, its main objectives are to understand the correlations between Lina Bo Bardi's and Philip Johnson' studios and their homes. The chosen methodological procedure for this research is organized on digital analyses based on different sources: original drawings, on site documentation and 3D scanning campaign, which were inserted in this paper in order to properly document the case study's geometries. It is expected that this research contributes to understand the minor works of these famous architects, completing the knowledge about their whole professional approach.

Keywords
Philibert de l'Orme, Castello di Anet, stereotomia, curve gobbe, analisi geometrica

Topics
Connecting / documenting / relating



Section of Casa de Vidro in Sao Paulo (drawings by the authors exported from the BIM model of the House).

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Introduction

This research was developed within the *I N S I D E* Modern Heritage international network, the cooperation net of academics and institutions that share the same interest toward modern heritage at different layers [www.inside-mh.com]. The worldwide research on modernist heritage began a few decades ago, but it has already drawn by many historians, academics, curators, authors, archivists, and journalists, all of which were eager to expand their knowledge on the subject in order to better comprehend a complex phenomenon [McDonald 2001; Normandin et al. 2013]. The worldwide interchange of architectural/artistic ideas and forms across the century, which resulted from the geographical movements and migrations of architects and engineers, is an essential trait to emphasize in this broad research subject. Because of these worldwide cultural and intellectual exchanges, it is critical to strengthen transnational collaboration by creating a network that can share best practices in research, recording, and improvement of Modern Heritage [Balzani et al. 2017].

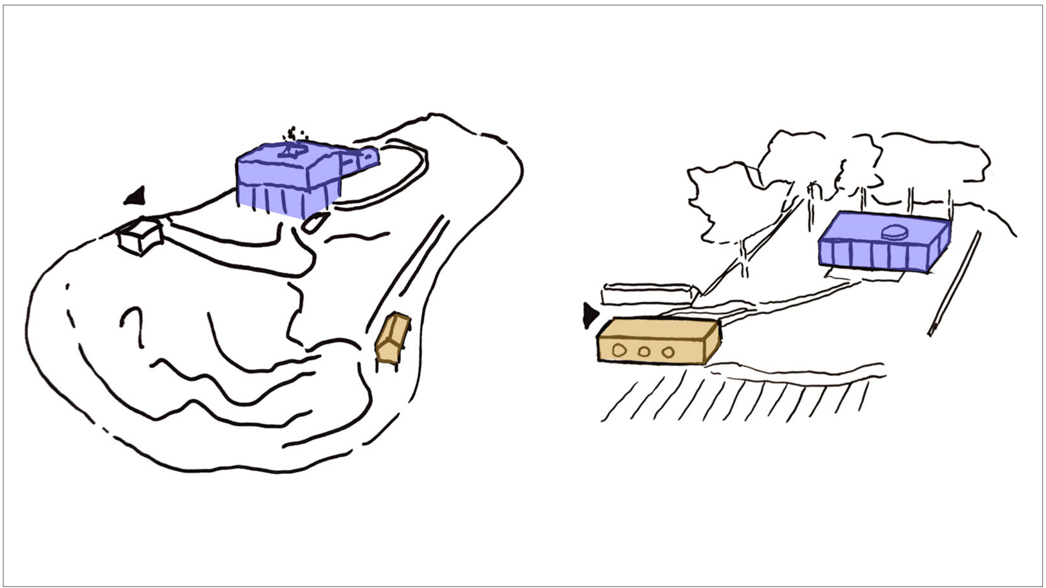


Fig. 01. Casa de Vidro in Morumbi, São Paulo, Brazil by Lina Bo Bardi (Left) and Glass House in New Canaan, Connecticut, USA, by Philip Johnson. The croquis show the area where the houses (purple) and the small studios (orange) are located within the two gardens (Sketches by the authors).

The object of study of this paper is the complex of annexes of the glass houses of Lina Bo Bardi and Philip Johnson, designed respectively in 1949 and 1948, in São Paulo (Brazil) and New Canaan (Connecticut-USA). Lina's complementary design is called "casinha" (*tiny house* in portuguese) and held her office, whilst Johnson's additional building is called "The Brick House" and held both private and office uses throughout its lifetime. That is, both constructions constitute annexes of their respective main iconic glass houses, and were later used as architectural offices by their famous architect owners. Both complexes today are destined for cultural use, after the passing of their authors, previous owners of both designs (fig. 01). The importance of the glass houses in architectural history dates to the manner architecture became connected with steel and glass throughout the industrialization period. The iconic Crystal Palace, built of plate glass, was the first monument of the era of invention. It was established in Hyde Park in 1851 as the site of the Great Exhibition, which showcased technical advancements (fig. 02-left side). Later, in 1914, the "Maison Dom-Ino" by Le Corbusier, a worldwide model that exhibited the foundations of contemporary architecture as perceived by its most famous architect, was undoubtedly the prototype for a modern glass house. It had an open floor layout, with no walls or impediments, and only a few columns symmetrically distributed around the perimeter [Aureli 2014].

The Dom-ino Problem resides in questioning the architecture of domestic space. The steps are positioned to enable access to all four sides of the floor, allowing for limitless interior configurations. Most crucially, the thin columns (in this case, reinforced concrete) allow for a glass-plate front, which is exactly what some of the world's most famous contemporary architects achieved (fig. 02-centre).

However, we can thank largely German modernists for the way we envisage glass homes today. Mies van der Rohe was a key figure in the development of the classic glass home. Mies's Farnsworth House designed in 1945 in the Chicago suburbs is situated in a somewhat rural micro-environment, surrounded by nature [Blaser 1999]. The Domino House concept is here contextualized in a setting that counterbalances the so-called cold, industrial aesthetics. In this case, the glass, which acts as a physical barrier between the interior and the outside, reveals its unique character as both transparent and reflecting. As the home mixes into the colours and contours of the natural terrain, it finally becomes a part of it, echoing the surroundings while also becoming a part of the house (fig. 02-right side). Therefore, this paper aspires to concatenate a graphical analysis of both the *Casinha* and the Brick House, in the sense of their transparency in comparison to their famous glass house counterparts. Another point of analysis chosen for this paper was the constructive media used in both complementary designs, culminating in designs with distinct visual lightness.To achieve such objectives, this paper counted heavily on the access of primary sources of both designs, gently ceded by their respective cultural institutes. In the case of Lina's casinha, there was the opportunity to use laser scanning surveying techniques associated to HBIM modelling. In the case of Johnson's brick house, the equivalent analysis was conducted by means of the access and analysis of the original drawings, their redrawing and interpretation.



Fig. 02. The rebuilt Christal Palace at Sydenham in 1930 (left– public domain image), the Dom-Ino house by Le Corbusier (1914) rebuilt for the Biennale of Architecture in Venice in 2014 (centre – public domain image). These iconic buildings are part of the process that led to contemporary glass house.

Casa de Vidro: a Brazilian glass house?

"Casa de Vidro" in Sao Paulo, Brazil, designed by Lina Bo Bardi was built between 1950 and 1951 in the Morumbi district. It is a paradigmatic example of the architect's complex work, full of ambivalence and ambiguity, centred on the tension between modernity and tradition. Although this building has often been reduced to the image of a "glass house", modern and crystalline, it could be perceived as the result of a hybrid conception of architecture, combining an erudite and rationalist universe with a vernacular one (fig. 03). The integration with the site orography has, at the same time, made the access to the house slightly problematical, with the chosen solution of a pretty steep paved road [Rossato 2020].Bardi's home is a hybrid building, composed of a transparent part with entirely glass walls, suspended on eleven slender steel *pilotis,* which houses the living room, dining area and library, and an opaque part, in white plastered brick, resting on the top of the hill, where the bedrooms, kitchen and service areas are located [Acayaba Milan, 2011]. The volume is enclosed by a roof with two delicate pitches, joined at the ridge by a slight curved line, and is cut by two courtyards: one marked by a glass wall in the suspended part, incorporating a pre-existing Ficus Elastica tree, and another separating the sleeping area from the servants' quarters.



Fig. 03. The casa de Vidro by Lina Bo Bardi main level and related section (drawings by the authors exported from the BIM model of the House).

Glass House by Philip Johnson: the perfection of the line

The best way to think of the Glass House is as a viewing pavilion for the surrounding area. The home lies on a promontory overlooking a pond with views to the forests beyond and is completely hidden from the road. The home is 16,9 by 10 meters broad and has a total area of 169 square meters. A centrally situated glass door that opens into the landscape punctuates each of the four outside walls. Because of its inventive use of materials and perfect incorporation into the landscape, the home, which brought in the International Style into domestic American architecture, is legendary [Tutter 2011]. Philip Johnson, who lived in the Glass House from 1949 until 2005, saw it as half of a composition that would be completed by the Brick House, in a way that both structures were created in 1948. The Glass House's floor layout depicts a very standard living room. Despite the absence of walls, Philip Johnson referred to the rectangular, loft-like interior as having "rooms." A kitchen, dining room, living room, bedroom, hearth area, bathroom, and entry space are all included (fig. 04).
The arrangement of furnishings around the house is accurate, as seen in the floor plan. The living room is defined by a rug and sitting around a modest table centres the space. The living room is the home's main point, and it serves as a nested box from which the site is sequentially occupied: living room, house, courtyard and landscape [Cassidy-Geiger 2016].

Working at home

In 1986 the studio, called "casinha" by Lina Bo Bardi, was added to her house and located on the northeast side of the hill and with its own access on Rua Bandeirante Angelo Sampaio (fig. 05 – left side). This is another enigmatic building, made of wood and with a pitched roof, inspired by vernacular Brazilian architecture. Fragile and temporary in appearance, based on a rigorous modular layout, it defines three work areas by means of wooden pillars made from logs. Adjacent to this pavilion, a square-based prism of white-painted bricks with a garden roof houses the bathroom and a small kitchen, divided by a diagonal wall reminiscent of the floor plan of Casa Cirell. The architect's working method is summed up in this building: preferring to compose a different work group for each project, without using permanent employees, she maintained a constant aptitude for experimentation and research, also mak-

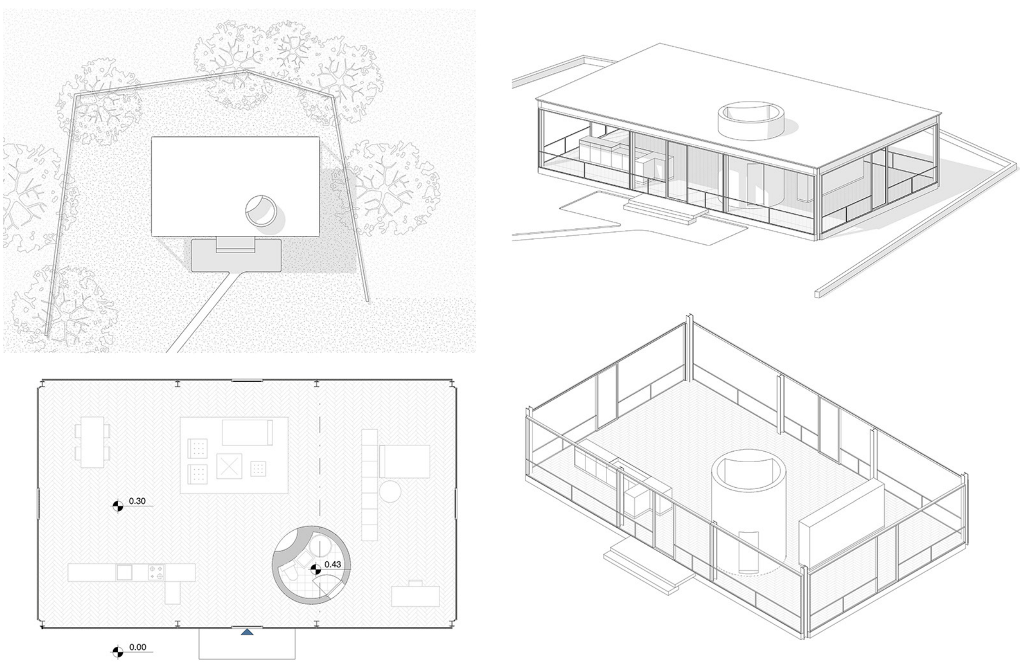


Fig. 04. Glass House by Philip Johnson (drawings by C. Campodipietro, D. Filipi, I. Gasparinetti, elaborations exported from the BIM model of the House).

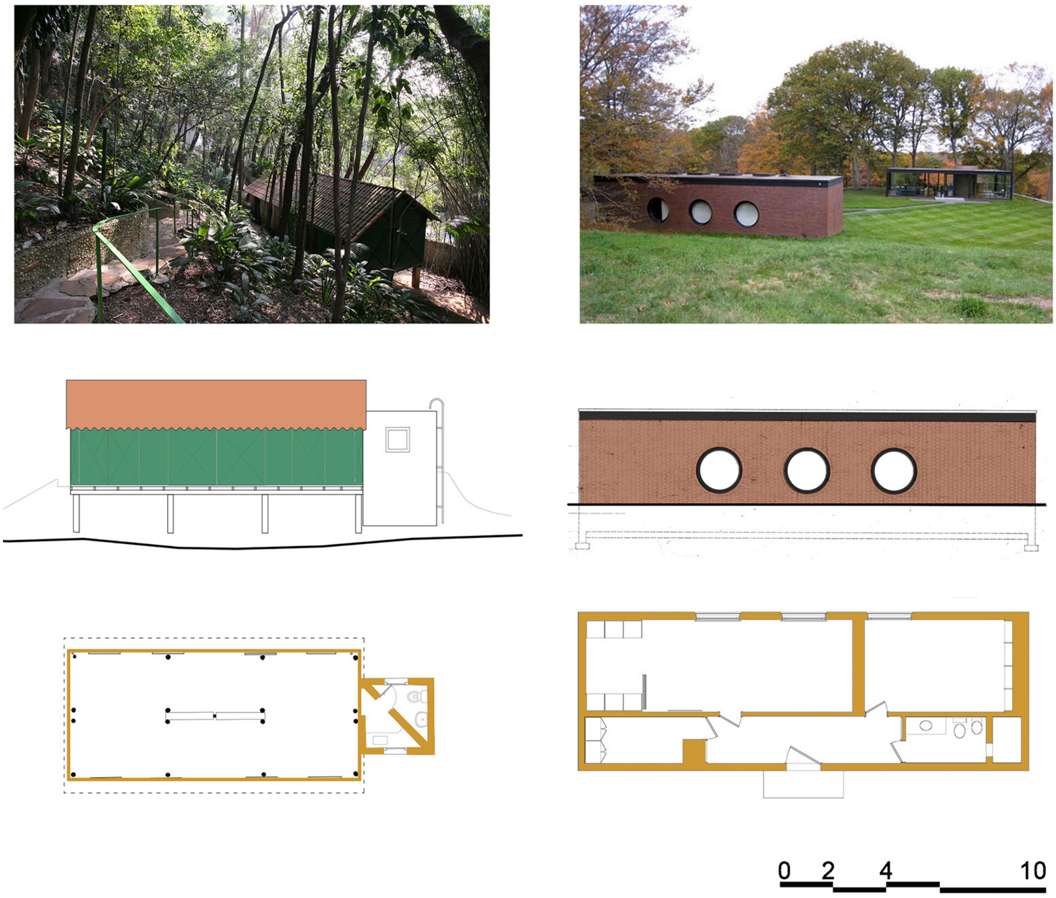


Fig. 05. Lina Bo Bardi´s (left) and Philip Johnson´s (right) studios at their glass houses, drawings are at the same scale.

ing use of the contributions of the workers and the unforeseen events on the building site. Lina Bo Bardi admired the knowledge that is produced in practice, through a tradition in constant movement. From this moment on, the house is complete, concretely becoming a place of design and production. However, Lina only used the studio for a few years because her health problems made it difficult for her to travel. The Brick House is just half as deep as Johnson´s Glass House, even though they are both more than 16 meters long, but the two houses were designed as a single unit. Brick nearly entirely encases the whole house, as opposed to the transparency of the Glass House. Except for the skylights, the only windows are huge circular shapes towards the back of the structure. This pattern of circular apertures, according to Philip Johnson, relates to Filippo Brunelleschi's fifteenth-century Duomo in Florence (fig. 05-right side). The design was initially separated by Johnson into three rooms, each with a porthole window and genuine walls. It was built for visitors, but Johnson quickly understood that he liked that space. So, in 1953, he rebuilt the Brick House, breaking with modernity for the first time by adding cocoon-like master bedroom with a vaulted ceiling. In 1997, the house was declared a Connecticut Historic Landmark. During his lifetime, Philip Johnson sold the property to the National Trust for Historic Preservation with the agreement that it would be accessible to the public after his death. Today it is used for art-related initiatives and temporary exhibitions.

Research design and first outputs

This research first examined the transparency present in both adjacent buildings to the glass houses. If Bardi's glass house has no transparency in its private sessions, the same

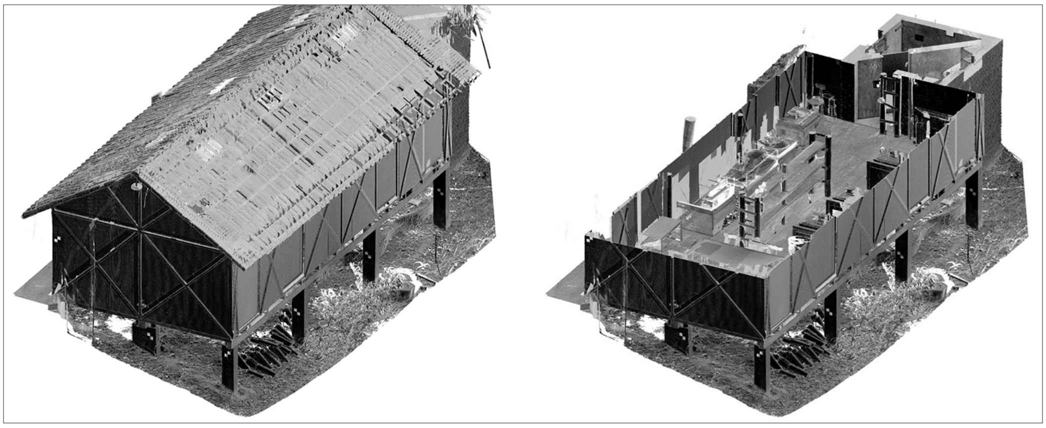


Fig. 06. the point cloud of the *casinha* of Lina Bo Bardi's glass house. The segmentation of the point cloud allows quick interpretation of the database.

cannot be said in Johnson's. In fact, Johnson's brick house was initially set up as a refuge for his family's privacy [Murtinho 2015]. The *hidden* research team, from the *hidden*, assisted the Institute of Architecture and Urban Design of the University of São Paulo (IAU-USP) and the Instituto Bardi-Casa de Vidro´s efforts to conceive a Conservation Management Plan, financed by the Getty Foundation. Such assistance came through the scanning of the house, and posterior training of the IAU-USP research team to manipulate the resulting point cloud data following the most updated protocols [Kioussi et al. 2012; Kioussi et al. 2015; Pavlidis et al. 2015]. An effective but affordable methodology for cataloguing Cultural Heritage through the adoption of standards for standards for inventorying, for the semantics of the 3D model, for data interchange could greatly improve the conservation of these architectures [Bertocci, Cottini 2017]. Such point cloud was of great assistance in order to understand the geometry of the casinha beyond the ordinary parametric modeling, but in the critic assessment of the construction. For example, in this paper, , the point cloud was lapidated in Autodesk Recap 2022®, in order to isolate the casinha from the abundant vegetation in the surroundings and the main building itself, which revealed the importance of the choice for light wood panels in the sealing of this particular construction amidst such harsh hot and humid weather conditions, revealed by the 3d surveying itself Accordingly, it is not surprinsgly that Recently the discipline of surveying has received attention from academic and non-academic researchers working in the field of design. This is owing to the diverse range of cultural interests represented in this discipline, which includes everything from geometry to design, procedures to systems. The size of the focuses considered is wide, ranging from object to landscape [Giandebiaggi 2018]. The comprehensive 3D recording of culturally important sites such as these houses can serve a variety of invaluable purposes [Pritchard 2017]. The database was transferred to Autodesk Revit®, and organized in appropriate levels, sections and elevations (fig. 06) towards a more effective representation layout [Bianchini et al. 2018]. Some elements were modelled to further comprehend Bardi's design, such as the floor slabs and façade panels. The main objective of the modeling itself was to understand the adaptation of the constructions' to their respective climates, since much is known regarding tempered weather architecture, yet little is known regarding adaptation towards tropical weather architecture. Just to cite an example, in Banham (1985) Argentina subtropical Buenos Aires is cited as the main tropical sample in *The Architecture of the Well-Tempered Environment*. Through this apprehension of the design, the HBIM model allowed it to determine that glass itself only constitutes 1,37 % of the casinha's surface (glass windows indicated in light blue in fig. 07). If the sliding doors spectre of aperture is considered into this transparency index, apertures in the casinha refer to 25,86% of its surface. A similar graphical analysis of aperture and transparency ratios was performed in Johnson´s brick house, through means of the access of the original drawings of the Glass House in *theglasshouse.org*. Since there was no point cloud available for Johnson´s glass house, upon the download of the original drawings of

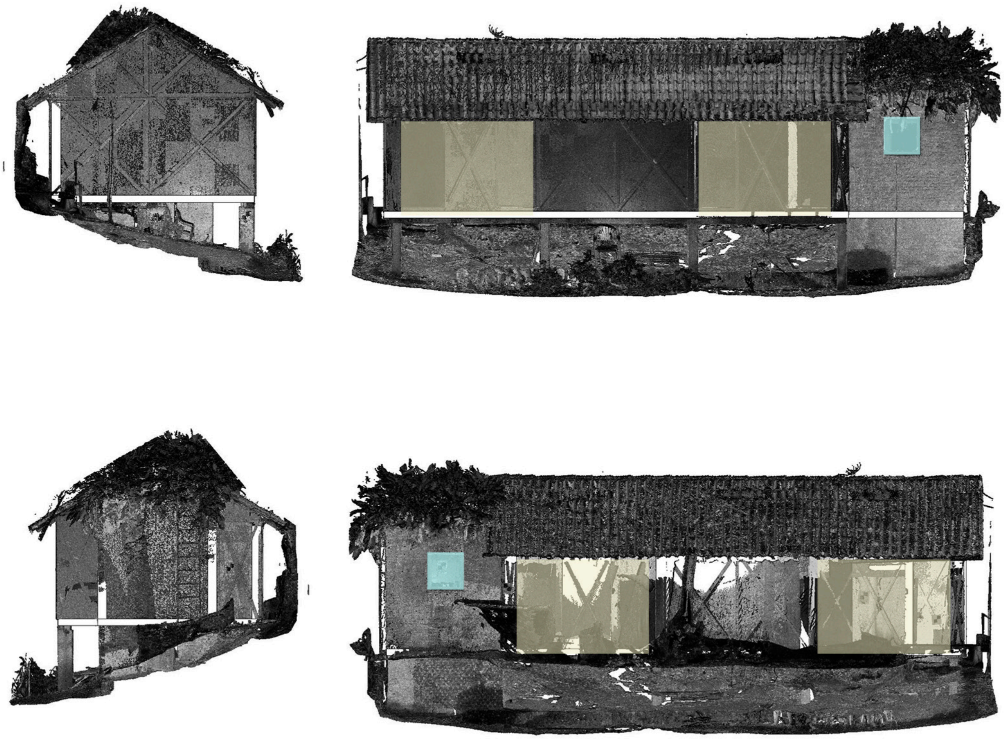


Fig. 07. Lina Bo Bardi´s transparency and aperture to surface graphical analysis, being the glass windows indicated in light blue and the sliding panels indicated in light yellow.

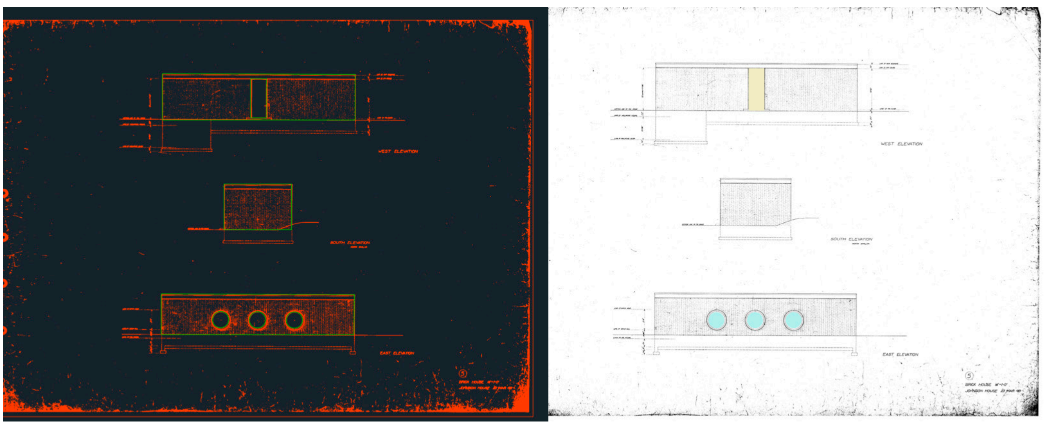
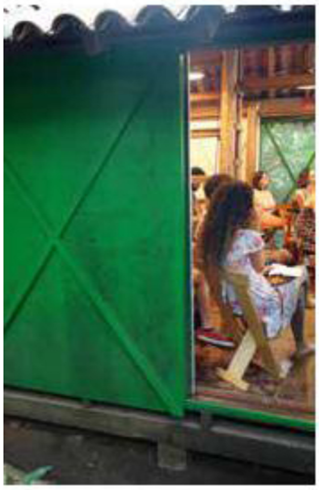


Fig. 08. Redrawing of the perimeter, windows, and aperture of the Brick House (left) and Philip Johnson´s transparency and aperture to surface graphical analysis, being the glass windows indicated in light blue and the sliding panels indicated in light yellow (right). Courtesy of theglasshouse.org.

the facades of the brick house, glass windows and the door apertures were computed by means of their redrawing in Autodesk AutoCAD 2022® (fig. 08).
The resulting analysis yielded a transparency index of 2,85 %. If the doors (light yellow in fig. 08) were considered as apertures, the secondary index resulted in only 5,72 %.
It is interesting to note how not transparent are both of those adjacent designs in comparison to their glass house counterparts. Lina's *casinha*, essentially an office, has even less glass transparency than the Brick House. However, when the casinha's sliding panels are considered (fig. 09), its aperture index is considerably superior to the Brick House. This could be due to the tropical weather conditions in São Paulo, Brazil, which demands cross-ventilation and low constructive *intertia* strategies in order to assure internal comfort. Such abundancy of wood in the casinha´s structure, as can be seen in the HBIM model, makes it as tectonically and constructively independent from the main glass house as happens with the Brick House, where obviously brick figures as the dominant constructive media. If in Johnson's glass house there is the predominance of steel and glass, Lina's glass is tempered



a



b



c



d

Fig. 09. The sliding wooden panels in Lina's *casinha* (a), wooden enclosures in the lateral façades (b), wooden elements in its interior (c) and bricks on the bathroom annex (d). Images courtesy of the Instituto Bardi.

with steel and reinforced concrete in its posterior private quarters. Thus, if Johnson's glass house is much more translucid and visually lighter than Lina's due to this posterior element, the inverse effect happens in the casinha and the Brick House. The Connecticut weather makes a dinstinct presence in Brick house's bricklaying strategy, doubled in the external facades. Lina's casinha is much lighter, visually speaking, with its thin panels that indeed need diagonal bracing in order to sustain buckling efforts (fig. 09-b).

Conclusion

While in Brazil the teachings of Le Corbusier were more widely followed, applying his principles to a tropical environment and mixing them with local traditions, in the United States Mies van der Rohe was the main model for many architects, especially Philip Johnson. The theorist of the International Style designed the house in New Canaan in 1949, where he lived with his partner David Whitney (1939-2005) until his death in 2005. The house is clearly modelled on the Farnsworth but differs from it for a number of reasons, from the corner solution to its relationship with the ground. The glass envelope rests on a low brick base, firmly rooted in the ground, positioned on a small promontory that Johnson immediately chose as the site for his house. As the seasons change, the interior space also changes radically. On the other hand, their annexes differ in their relationship and resulting

architecture from their famous glass counterparts. The Brick house was designed at the same moment than the Johnson's Glass House, being slowly occupied due to its opportunity to provide privacy. However, the *casinha* was incorporated to Lina's Glass House almost forty years after the main house's construction. The casinha's design resulted in a much more aired and illuminated space, compatible to São Paulo's tropical weather, as opposed to the heavy and virtually total brick enclosure of the Brick House. This relationship of coexistence of a transparent and an opaque part is also present in Casa de Vidro, but while Johnson keeps the two blocks separate and perceptively different, Lina blends them into a unitary, hybrid organism.

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